VERONTE
AUTOPILOTS

Hardware User Manual

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Acronyms

ADC	Analog to Digital Converter
AWG	American Wire Gauge
CAP	Capture Module
DC	Direct Current
DGPS	Differential GPS
DTS	Digital Transmission System
ECAP	Enhanced CAP
EGNOS	European Geostationary Navigation Overlay Service
EPWM	Enhanced PWM
FCS	Flight Control System
FHSS	Frequency Hopping Spread Spectrum
FTS	Flight Termination System
GIS	Geographical Information System
GND	Ground
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning System
GS	Ground Segment
ISM	Industrial Scientific and Medical
LADGPS	Local Area
LOS	Line of Sight
PWM	Pulse Width Modulation
PWR	Power
RF	Radio Frequency
RS232	Recommended Standard 232
RX	Receiver
SMA	SubMiniature Version A Connector
TX	Transmitter
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle

1. Overview

Veronte is the main element in our Flight Control System for UAS. As it can be seen in the diagram, Veronte hardware is used both in the ground segment (**G**round) and onboard the UAV (either **A**ir or **V**ision).

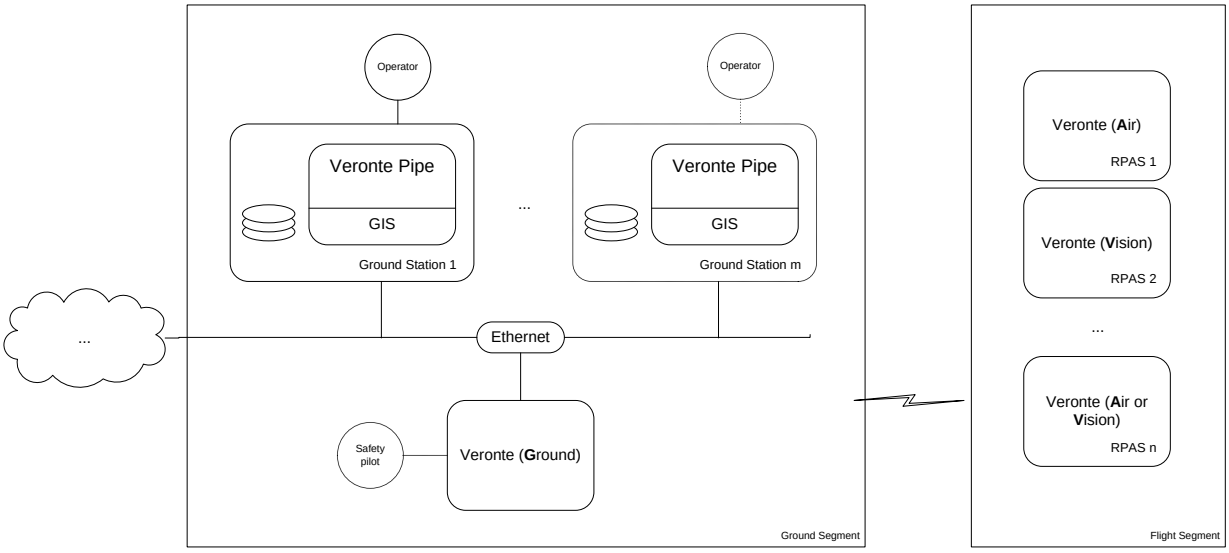


Figure 1: Veronte FCS Overview

Veronte contains all the electronics and sensors needed in order to properly execute all the functions needed to control the UAV. A Veronte-based FCS contains the following elements:

- Veronte (**A**ir): it executes in real time all the guidance, navigation and control algorithms for the carrying airframe, acting on the control surfaces and propulsion system and processing the signals from different sensors: accelerometers, gyroscopes, magnetometer, static pressure, dynamic pressure, GPS (EGNOS/Galileo compatible).
- Veronte (**V**ision): alternative to Veronte Air. Same functionalities as **A**ir plus video/vision capabilities.
- Veronte (**G**round): apart from linking to other flying Veronte units and supporting manual and arcade modes with conventional joysticks, it can also control a directional antenna in order to expand the maximum range. It communicates to Veronte Pipe (software for ground segment mission management).
- Veronte Pipe: software for mission management at the ground segment. It monitors flying vehicles in real time and can also reproduce past missions in an offline manner. It is also the graphical user interface where commands and flight plans are produced.

2. Aircraft Mounting

2.1.1. Enclosure

Veronte is provided using an anodized-aluminium enclosure with enhanced EMI shielding and IP protection. The total weight including a 900 MHz / 2.4GHz radio module is 190 g.

Figure 2: Veronte Air

All Veronte versions share the same enclosure. The only difference is the distribution of the connectors on the panel.

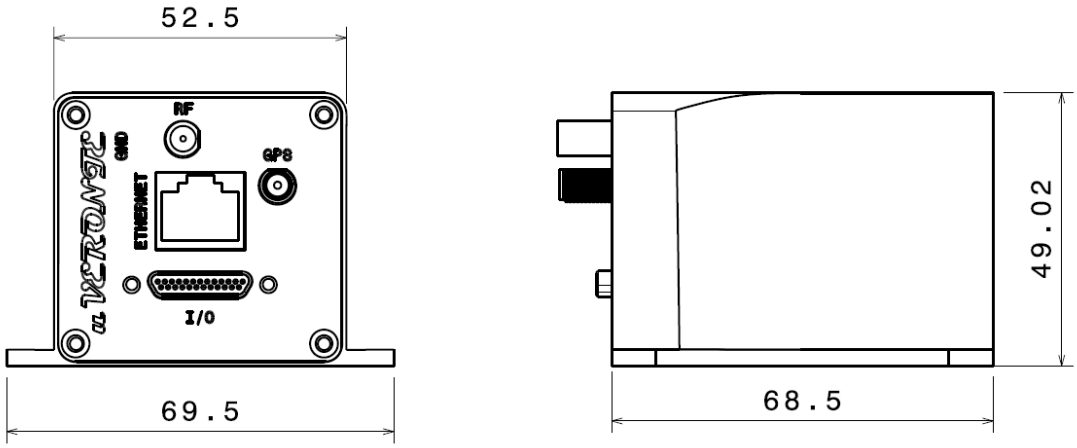
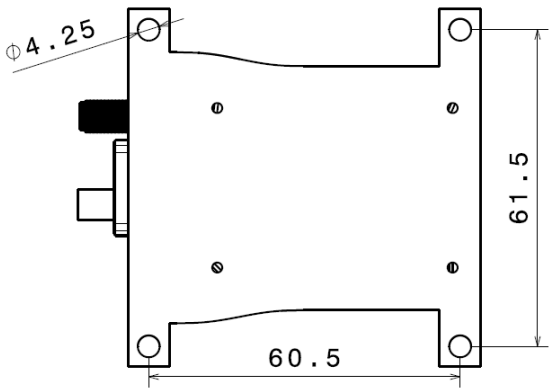


Figure 3: Veronte dimensions (mm)

2.1.2. Mechanical Mounting



M4 screws are recommended for mounting.

Figure 4: Veronte mounting dimensions (mm)

2.1.3. Vibration Isolation

Although Veronte ultimately rejects noise and high-frequency modes of vibration with electronic filters, an adequate vibration isolation design can improve the performances and extend the lifetime of Veronte.

Veronte can be mounted in different ways in order to reject the airframe vibration. The simplest could be achieved by just using a double-sided foam tape on the bottom side of Veronte. Other ways may use some external structure which could be rigidly attached to the airframe and softly attached to Veronte (e.g. foam, silent blocks, etc.)

The user should take into account that wiring should be loose enough so vibrations may not find another way to enter the aircraft system.

In cases where Veronte isolation is not viable, it is possible to use soft engine mounts. It is also recommended when there are other sensible payloads like video cameras or for high vibration engines.

Figure 5: Engine Mounts

2.1.4. Location

The location of Veronte has no restrictions. You only need to configure its relative position with respect to the centre of mass of the aircraft and the GPS antenna. The configuration of the location of Veronte can be easily configured using Veronte Pipe Software.

2.1.5. Orientation

The orientation of Veronte has no restrictions either. You only need to configure Veronte axes with respect to the aircraft body axes by means of a rotation matrix or a set of correspondences between axes. The configuration of the location of Veronte can be easily configured using Veronte Pipe Software.

Veronte axes are printed on the box and aircraft coordinates are defined by the standard aeronautical conventions.

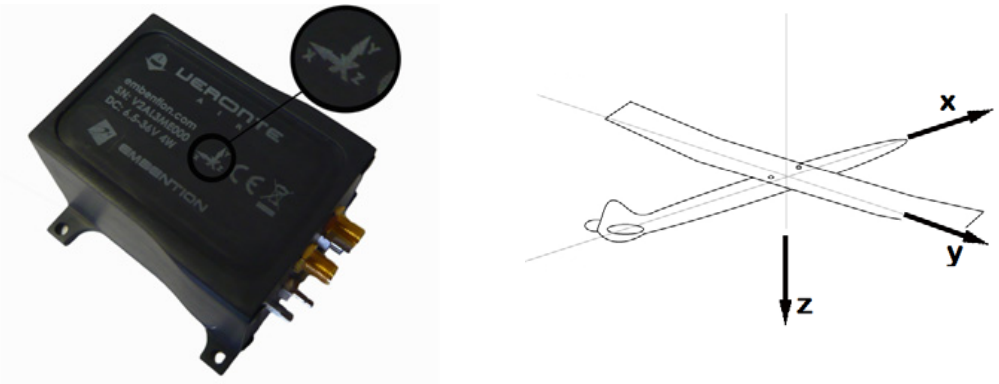


Figure 6: Veronte & Aircraft Axis

2.1.6. Connector Layout

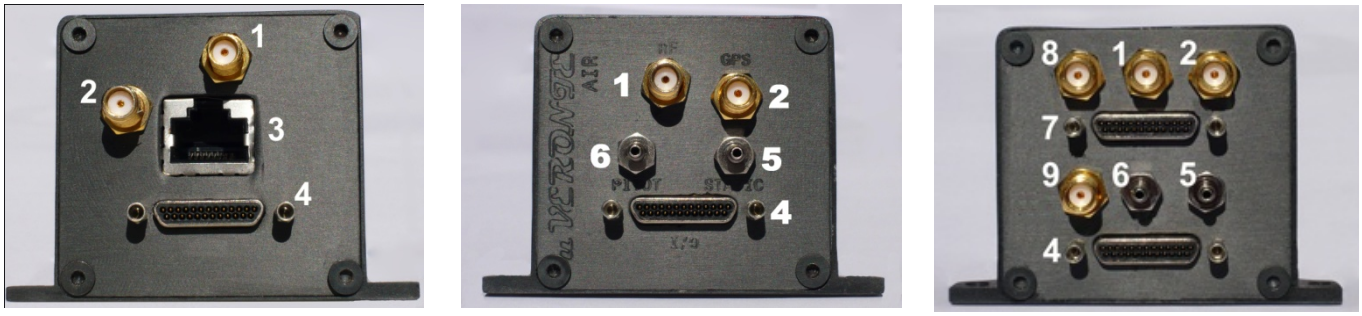


Figure 7: Left to right: Veronte Ground, Air and Vision

Index	Connector	Veronte (Ground)	Veronte (Air)	Veronte (Vision)
1	RF antenna (SMA Jack Female)	✓	✓	✓
2	GPS antenna (SMA Jack Female)	✓	✓	✓
3	Ethernet (RJ-45)	✓	×	×
4	Veronte power and I/O (Micro-D)	✓	✓	✓
5	Static pressure port (Fitting 5/64in)	×	✓	✓
6	Dynamic pressure port (Fitting 5/64in)	×	✓	✓
7	Vision power and I/O (Micro-D)	×	×	✓
8	Composite Video (SMA Jack Female)	×	×	✓
9	WIFI (SMA Jack Female)	×	×	✓

Table 1: Veronte connection panel

For both pressure ports, mating with clamped 2mm internal diameter flexible tubing is recommended.

2.1.7. Mating Connectors

Index	Connector	Mating Connector
1a/1b	RF antenna (SMA Jack Female)	SMA Plug female, low-loss cable is recommended (e.g. RG-174, RG-316) Antenna 900 MHz Whip, 1/2 wave Omni directional 2 dBi
2	GPS antenna (SMA Jack Female)	SMA Plug female, low loss cable is recommended (e.g. RG-174, RG-316) Active Antenna GPS: Gain min 15dB (to compensate signal loss in RF Cable) max 50dB, maximum noise figure 1.5dB, power supply 3.3V max current 20 mA
3	Ethernet (RJ-45)	RJ-45 Plug Shield, Cat 5e
4a/4b	Power and I/O (Micro-D)	Receptacle 25-pin Micro-D connector • Molex: 83424-9019(18in, 28AWG) Commercial Version • Norcomp: CCA-025-I18R152 (18in, 28AWG) Commercial Version • ITT Cannon: MDM-25SH003L (18in, 26AWG) High performance version

Table 2: Mating Connector Table

2.1.8. Antenna Integration

The system uses three antennas to operate that must be installed on the airframe, one for radio communications and another for GPS positioning. Here you can find some advices for obtaining the best performance and for avoiding antenna interferences.

Antenna Installation
• Maximize separation between antennas as much as possible. • Keep it far away from alternators or other interference generators. • Always isolate antenna ground panel from the aircraft structure. • Make that the antenna is securely mounted. • Always use high quality RF wires minimising the wire length. • Always follow the antenna manufacturer manual.
GPS Antenna
• Antenna top side must point the sky. • Install it on a top surface with direct sky view. • Never place metallic / carbon parts or wires above the antenna. • It is recommended to install it on a small ground plane.
Communication / video Antenna
• It is recommended to use Omni directional antennas. • It should be installed vertically on the aircraft. • It is recommended to install it on a ground plane following manufacturer indications. • Place it in order to maximise the LOS with the control station. • Avoid any element that could block antenna communications.

Table 3: Antenna Installation

2.1.9. Pressure Lines

Veronte has two pressure input lines, one for static pressure to determine the absolute pressure and one for pitot in order to determine the dynamic pressure.
Absolute pressure connection on the aircraft is mandatory while pitot port can be obviated in some aircrafts, pitot port absence must be configured on Veronte Pipe software.

Pressure Intake
• Pressure intakes must be located in order to prevent clogging. • Never install pressure intakes on the propeller flow. • Design pressure tubing path in order to avoid tube constriction.
Static Pressure
• It is not recommended to use inside fuselage pressure if it is not properly vented.
Pitot Tube
• Pitot tube must be installed facing the airflow in the direction of the “x” axis of the aircraft. • It is recommended to install it near the aircraft axis in order to avoid false measures during manoeuvres. • For low speed aircrafts it is recommended at least 6,3mm tubes for preventing rain obstruction.

Table 4: Pressure Intake Connect

It is recommended to use Embention dual Pitot tube, including both, static and pitot intakes.

⚠ **Caution!!** Pitot pressure ranges are configurable on Veronte Hardware when placing an order, please review that selected sensor fits with aircraft speed.

3. Electrical

3.1.1. Power

Veronte can use unregulated DC **(6.5V to 36V)** for a total power consumption of; 4W including radio module and 10W including both, radio and Vision. Pins used for power and ground are the same for both **G**round and **A**ir/**V**ision configurations.

Signal	4a Pin	Battery Pole
VIN	14	Positive (+)
GND1	15	Negative (-)

Table 5: Veronte Power and Ground Pins

LiPo batteries between 2S and 8S can be used without regulation needs. Remaining battery can be controlled by the internal voltage sensor and by configuring the voltage warnings on the PC application.
For higher voltage installations, voltage regulators must be used. For dimensioning voltage regulators take into account that a blocked servo can activate regulator thermal protection and carry to a power cut. It is recommended to use Embention high performance UAV regulators.

⚠ **Caution!!** Power Veronte out of the given range can cause irreversible damage to the system. Please read carefully the manual before powering the system.

Veronte and servos can be powered by the same or different batteries, in case there is more than one battery on the system it is needed to ensure a **single union of different ground.** The ground signal should be isolated from other system ground references (e.g. engines).

It is recommendable to use independent switches for autopilot and motor / actuators. During the system initialization, PWM signal will be fixed to low level (0V), please make sure that actuators / motor connected support this behaviour before installing a single switch for the whole system.

3.1.2. Veronte I/O Signals

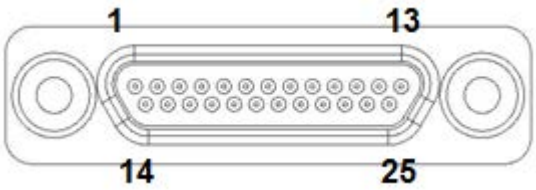


Figure 8: 25-pin Micro D connector for Veronte Autopilot I/O (4) (Veronte connector view)

Signal	Input	Output	Pin	Comments
VIN	Positive (+)	-	14	6.5 to 36V
GND1	Negative (-)	-	15	
PWM1	-	5V (12mA)	1	Veronte offers the option to directly drive up to 12 servos/ESCs with PWM outputs. PWM rate goes from 50Hz up to 400Hz. Note: PWM11 can be used as FTS independent logic output on demand.
PWM2	-	5V (12mA)	2	
PWM3	-	5V (12mA)	3	
PWM4	-	5V (12mA)	4	
PWM5	-	5V (12mA)	5	
PWM6	-	5V (12mA)	6	
PWM7	-	5V (12mA)	7	
PWM8	-	5V (12mA)	8	
PWM9	-	5V (12mA)	20	
PWM10	-	5V (12mA)	21	
PWM11 (FTS)	-	3.3V (12mA)	16	
GND2	-	-	9	GND for PWM1…11
PWM12 (DIGIN2)	4V to 9V (on demand)	5V (12mA)	23	Note: PWM12 can be used as a digital input on demand.
GND3	-	-	24	GND for PWM12 (GND DIGIN2)
RS232TX	-	±5V (35mA)	10	It supports baud rates up to 115200bps.
RS232RX	±25V	-	11	
GND4	-	-	13	GND for RS232
DIGIN1	4V to 9V	-	12	CMOS/TTL with interrupt capability.
GND5	-	-	17	GND for DIGIN1
ADCIN1	0V to 36V	-	25	User-defined analog signal
GND6	-	-	18	GND for ADCIN1
CANHI	-7V to 12V	-7V to 12V (50mA)	22	CANbus interface. It supports data rates up to 1 Mbps. Recommended cable is a twisted pair with a 120Ω Zo.
CANLO	-7V to 12V	-7V to 12V (50mA)	19	

Table 6: Veronte I/O interface (4)

3.1.3. Vision I/O Signals

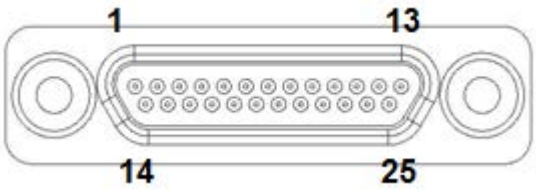


Figure 9: 25-pin Micro D for Veronte Vision (7) (Veronte connector view)

Different connections can be used depending on your camera configuration.

Signal	Input	Output	Pin	Comments
VCC			1	POWER
GND			2	POWER
RS_232_OUT		X	3	COMMUNICATION BUS
RS_232_IN	X		4	COMMUNICATION BUS
RS_232_GND			5	GND FOR RS-232
CSI2C_DY0/D7_3.3V	X	X	6	CSI2C_CLK+_OUTPUT/D7 BT-656 INPUT
CSI2C_DX0/D6_3.3V	X	X	7	CSI2C_CLK-_OUTPUT/D6 BT-656 INPUT
CSI2A_DY2/D1_3.3V	X		8	CSI2A_DATA1+_INPUT/D1 BT-656 INPUT
CSI2A_DX2/D0_3.3V	X		9	CSI2A_DATA1-_INPUT/D0 BT-656 INPUT
GND			10	POWER
CSI2C_DY1/RX232_EXTRA	X		11	CSI2C_DATA0+_INPUT/RS-232 INPUT
CSI2C_DX1/TXC232_EXTRA	X	X	12	CSI2C_DATA0-_INPUT/RS-232 OUTPUT
GND			13	POWER
D5/CSI2A_DX1	X		14	CSI2A_DATA0-_INPUT/D5 BT-656 INPUT
D4/CSI2A_DY1	X		15	CSI2A_DATA0+_INPUT/D4 BT-656 INPUT
D3/CSI2A_DX0	X	X	16	CSI2A_CLK-_OUTPUT/D3 BT-656 INPUT
D2/CSI2A_DY0	X	X	17	CSI2A_CLK+_OUTPUT/D2 BT-656 INPUT
GND			18	POWER
PCLK\LVDS_A	X		19	CLK BT-656 INPUT/LVDS_A INPUT
CAM_RESET/LVDS_B	X	X	20	CAM RESET OUTPUT/LVDS_B INPUT
CAM_SCCB		X	21	I2C SIGNAL
CAM_VBUS/SHUTTER (USB)		X	22	USB POWER/SHUTTER OUTPUT
CAM_ID/SCL (USB)	X	X	23	USB ID/I2C CLK
CAM_DP/SDA (USB)	X	X	24	USB DATA_P/I2C DATA
CAM_DM/SCCB (USB)	X	X	25	USB DATA_M/I2C SIGNAL

Table 7: Vision I/O interface (7)

⚠ **Caution!!** Veronte Vision has an independent power input. It is required when the Veronte power source is under 10 V.

3.1.4. Joystick

To connect the joystick to the system, use the DIGIN1 port on Veronte Ground connected to the radio trainer port.
Veronte is compatible with standard PPM signals, Futaba radios between 8 and 12 channels are recommended.

Pin	Designation	Connector
SHIELD	GROUND	
1	$V_{ENCODER}$	
2	PPM_{OUT}	
3	PPM_{IN}	
4	V_{ENC2}	
5	$V_{BATTERY}$	
6	UNKNOWN	

Pin	Designation	Connector
1	NC	
2	GROUND	
3	PPM_{OUT}	
4	$V_{BATTERY}$	
5	$V_{ENCODER}$	
6	PPM_{IN}	

Figure 10: Futaba Trainer Port

Signal	Veronte	Radio	Comments
PPM	DIGIN1	PPM_{OUT}	
GND	GND5	Ground	

Table 8: Joystick Connect

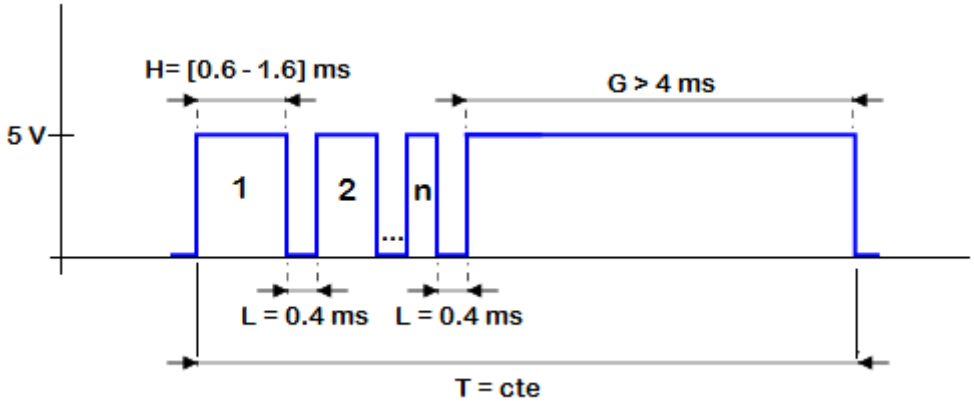


Figure 11: PPM Signal

As default, channel 8 is reserved for manual / auto switch. High level is used for automatic flight and low level for manual control. This channel can be configured on Veronte Pipe.

⚠ **Caution!!** PPM signal must be into the PPM ranges given with voltage above 4V. Some joysticks may need an adaptation board, please ask our team to check compatibility.

3.1.5. External Radio

Veronte is also offered with a RS-232 connector to be used with an external radio.

Figure 12: External Radio Connector

The mating radio connector for this configuration is: Phoenix Contact - 1681172

Signal	Input	Output	Pin	Comments
RS232 Veronte TX	-	±5V (35mA)	1	
RS232 Veronte RX	±25V	-	3	
RS232 Veronte GND	-	-	4	

Table 9: External Radio Connect

3.1.6. IP67 Version

IP67 autopilot is supplied with no 25 pin micro D connector in order to ensure highest environment protection. It is supplied with individual wire leads as follow.

PIN	Colour
1	Black
2	Broun
3	Red
4	Orange
5	Yellow
6	Green
7	Blue
8	Violet
9	Grey
10	White
11	Pink
12	Light green
13	Black / White

PIN	Colour
14	Broun / White
15	Red / White
16	Orange / White
17	Green / White
18	Blue / White
19	Violet / White
20	Red / Black
21	Orange / Black
22	Yellow / Black
23	Green / Black
24	Grey / Black0
25	Pink / Black

4. Performances

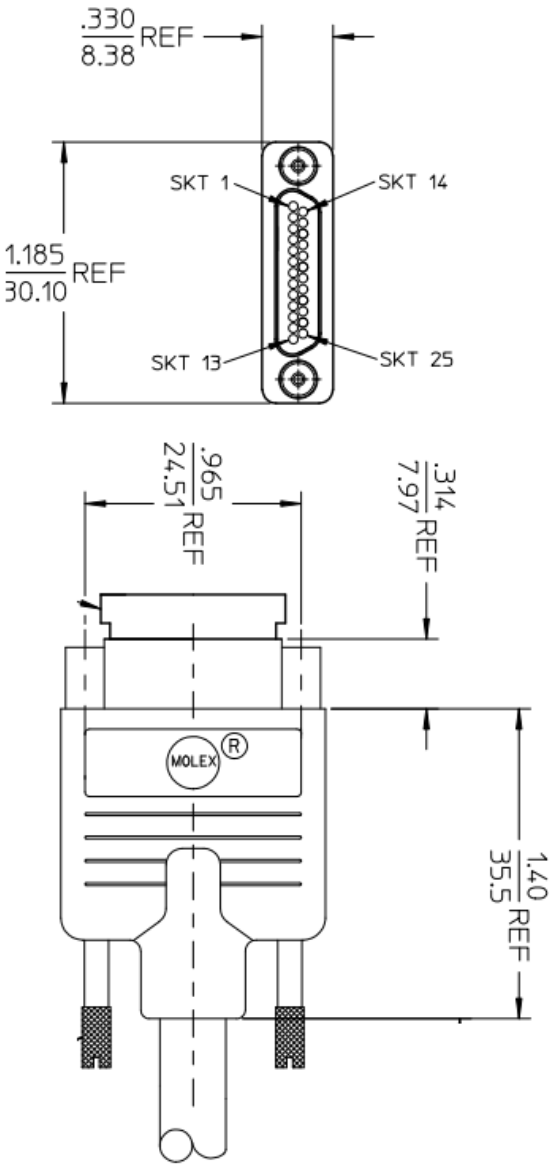
Variable	Value
Weight (900MHz /2.4GHz radio included)	190g
Power Input	6.5V to 36V (4W) (10W for Vision)
Minimum Temperature	-40ºC
Maximum Temperature	+55ºC[1]
Minimum Pressure	15kPa
Maximum Pressure	115kPa
Maximum Dynamic Pressure	10kPa [2]
Protection Rating	IP54[3]
Acceleration Limits (3 axes)	±6g[4]
Angular Velocity Limits (3 axes)	±300deg/s[5]
Magnetic Field Limits (3 axes)	±6Gauss
GPS	12 channels, DGPS EGNOS, LADGPS
Datalink	902-928MHz FHSS DTS / Range 96km / 115kbps 2.4 to 2.483 GHz ISM Band / Range 32km / 115kbps X-868 MHz ISM / Range 40km / 4 Kbps X-902 to 928 MHz / Range 45km / 10 kbps

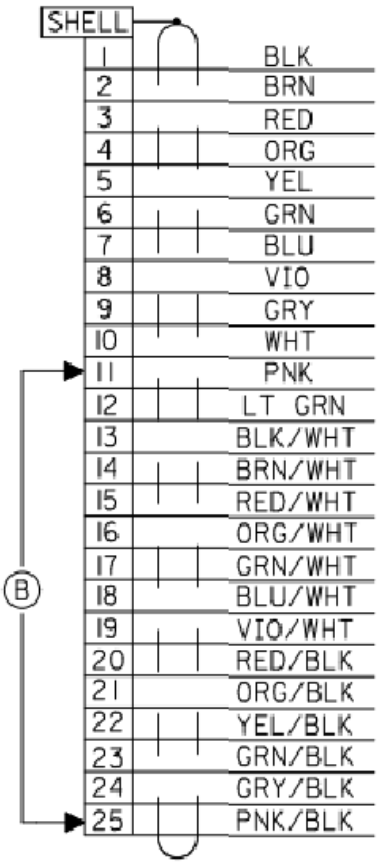
Table 10: Veronte performances

[1] No convection, ask for increased limits (up to 71ºC)
[2] Ask for increased limits (up to 50kPa)
[3] Ask for increased limits (up to IP67)
[4] Limit for sustained maneuvers. Transitional higher accelerations are possible (e.g. catapult launch). Ask for increased limits.
[5] Limit for sustained maneuvers. Transitional higher angular velocities are possible. Ask for increased limits.

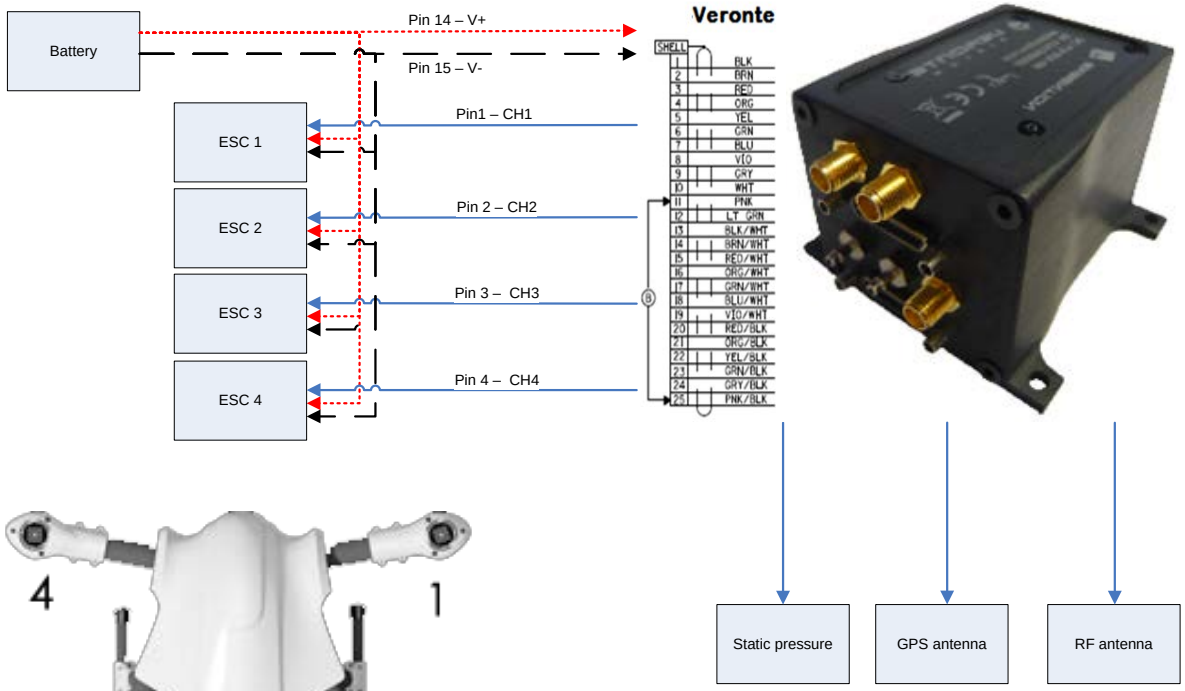
5. Annex 1: Connector Colour Code

Micro-D connector Molex 83424-9019

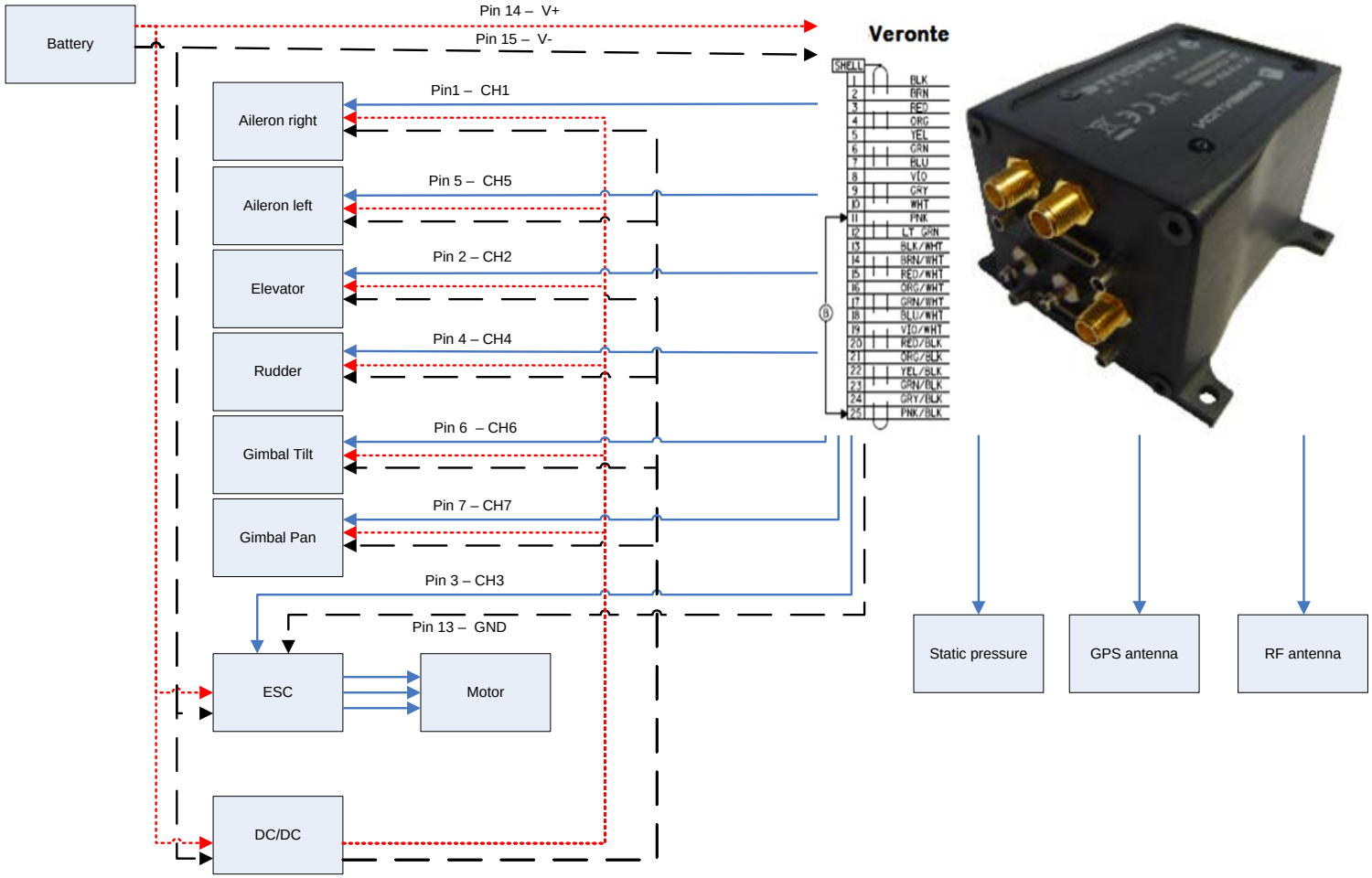




6. Annex 2: Connexion example – Multicopter



7. Annex 3: Connexion example – Fixed wing



8. Annex 3: Connexion example – Helicopter